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Application of repurposing in design education within the framework of sustainable design approach

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Abstract

The development of the sustainability concept began primarily in the European continent. Its integration into lifestyles and with it, the increase of social awareness, were formed with the contributions of various NGOs. In this context, we see the contribution of integrating sustainable design principles into the academic program. The factors that are important in sustainable design such as lower usage of raw materials, environmentally friendly materials, convenience in production and assembly, energy consumption, and ease of recycling are conveyed to the students through various courses in the academic program. A case study was carried out to analyze the transfer of sustainable design principles to the education process and its implications. This research was carried out in three stages: creating a theoretical framework, fieldwork, and practical work with students who attended the Sustainable Design course. According to the results students create new designs before recycling waste products within the scope of repurposing concept.

Keywords: Repurposing, sustainability, industrial design, education, application

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1. Introduction

The global prominence of the sustainability concept started with the UN World Commission on Environment and Development's publication of the Brundtland report in 1987. In the report, sustainability has been linked to development, the environment and equality. In 2015, all United Nations member states adopted the 2030 agenda for sustainable development with 17 sustainable development goals. Each goal has specific targets to be achieved over the next 15 years. Two of the sustainable development goals that are linked to the concept of this study are SDG 12 and 15. SDG 12 is responsible consumption and production; production is the driving force of the economy, but considering the overproduction and consumption leading to resource depletion, it is necessary to develop alternatives to address this problem.

SDG 15 is life on land, which is linked with nature, environment and preservation of the species. According to the 2019 Global Assessment Report on Biodiversity and Ecosystem Services, 'Human activity has altered almost 75% of the earth's surface, squeezing wildlife and nature into an ever-smaller corner of the planet and around 1 million animal and plant species are threatened with extinction'.

The major problem related to the two SDGs is the landfill; overproduction and consumption affect the life on land and leave a restricted area for wildlife and nature. In nature's eco cycle, there is essentially no waste; the waste of one organism becomes the nutrient of another and this is the principle of sustainability. As waste is a resource and environmental problem, emulating natural cycles, Reduce–Reuse–Recycle (3R), can be a solution. Extending the life cycle of waste products and reusing the materials for a new purpose before recycling or sending them to a landfill is an approach to mimic natural cycles. Most of the products are discarded and become waste before the end of product life and these products end up in landfills. As for the cradle-to-grave paradigm of McDonough and Braungart (2002), 'resources are extracted, shaped into products, sold, and eventually disposed of in a "grave", usually a landfill or incinerator'. Therefore, the landfill is a major problem and has been defined by ISWA (1992, p. 68) as 'the engineered deposit of waste onto and into land in such a way that pollution or harm to the environment is prevented and, through restoration, land provided which may be used for another purpose'. The discipline of the design is an important part of this cycle, and most of the industrial product designs are either recycled or disposed of in the landfills at the end of their life cycle. When considering the term sustainability in design, it covers a process ranging from raw material, manufacture, transportation, usage, end of the product's life cycle and recycling. In this context, the role of the designer changes, and hence the responsibility increases. Designers can make a significant difference in the effect of a product because they are responsible for influencing the key decisions. These determine the 'choice of materials, how long the product will last, how effectively it uses energy and how easily it may be reclaimed and re-used' (Mackenzie, 1991). Designers and product developers are in a key position to influence and reduce environmental impacts and thereby have the ability to contribute to a sustainable future. Basic D4S techniques for products and processes include increasing energy efficiency, using recycled materials, designing for recyclability, reducing toxic materials, extending product life and providing services in new ways.

Addressing sustainability issues in industrial design education is gaining importance. The production, use and disposal of industrial design products have many impacts on the environment. Therefore, integration of sustainability into the curriculum and building student's knowledge of approaches to sustainable design has become an important factor in design education. In this study, the sustainable design practices in an elective course; 'Sustainability in Design' will be introduced. In this context, we see the contribution of integrating sustainable design principles into the academic programme. The factors that are important in sustainable design such as less raw material use, usage of environmentally friendly materials, convenience in production and assembly, energy consumption and ease of recycling are conveyed to the students through various courses in the academic programme. The aim of the 'Sustainability in design' course is to teach the knowledge of sustainability

and the design issues through the sustainability approach. The final project of the course is to design a product by using sustainable design practice – repurposing.

2. Literature review

‘Repurposing’ or ‘Design for Reuse’ is the term for creating a new life for waste materials. In this research, repurposing is making new designs by using waste materials and creating a new life before the recycling process. There are various definitions for ‘Repurposing’; according to Aguirre (2010), ‘Repurposing is creating a new or a second life for an existent product by making some transformations to it’. Scott and Weaver (2018) define repurposing as ‘When a product no longer has value in its current condition or for its original purpose, a decision must be made regarding whether to throw it away, donate it, recycle it (if possible), store it, or reuse it for a different purpose’. As for McDonough and Braungart’s (2002) ‘cradle-to-cradle’ thinking, they recognise the value of materials and promote the idea of reprocessing and reusing redundant materials providing an important lease of life to a material rather than condemning it. It is an evolved design strategy that proposes that it is possible to design a product with qualities, features and details that facilitate repurposing (Aguirre, 2010). According to Schild (2020), repurpose is a circular strategy in between reuse and recycle. Repurposing is the act of recreating a waste item for another functional use. The term ‘repurposing’ is used to describe the process that utilises discarded waste products to create new industrial design products. Like extending product life, designing products to have uses past their normal intended use keeps their materials outside of the waste stream. Reusing a product’s materials (such as components or waste) is one approach (Shedroff, 2009, p. 305). The benefit of the reuse approach is that unlike many recycling methods that require reprocessing a reuse agenda is ultimately more sustainable (Bromston & Maycroft, 2014, p. 126).

The benefits of repurposing are both economic and environmental. Repurposing saves energy when both the production cycle of a new product and also the recycling process are evaluated. Repurposing preserves environmental conditions and reduces pollution. It helps the environment by minimising the energy spent on industrial production and recycling (which creates toxic material that pollutes the environment) (Aguirre, 2010). When considering the stages of the life cycle of a new product; raw material extraction, manufacturing, transportation, use, disposal, recycle–repurposing stands out in terms of economy and efficiency.

This study examines the application studies and results of design students to create new designs before recycling waste products within the scope of repurposing concept. A case study was carried out to analyse the transfer of sustainable design principles to the education process and its implications by a ‘repurposing’ project.

3. Methodology

The purpose of this study was to demonstrate educational strategies applications of repurposing design with the scope of sustainability. This research was carried out in three stages: creating a theoretical framework, fieldwork and practical work with students who attended the elective course – ‘Sustainability in Design’. The course is an elective course for industrial design students and the general intent of this course is to explore the concepts of green and sustainable design, the features and benefits from an interdisciplinary, critical and philosophical perspective. The learning outcomes of the lecture are to obtain knowledge about environmental impacts related to the product, to ensure sustainable use of energy and material sources throughout the design process and to design a new product with the lowest environmental footprint. The repurposing project is the final project of the course and the aim is to use disposed products to design a new product while applying creative problem-solving techniques with a sustainable design perspective.

In the first phase of the study, theoretical background of the repurposing concept was given and defined to the students for their final project. During the lecture, the history of repurposing, the scope

of the concept and implemented projects were demonstrated and discussed. In the planning of the repurposing concept project, the project definition and function was determined before the fieldwork.

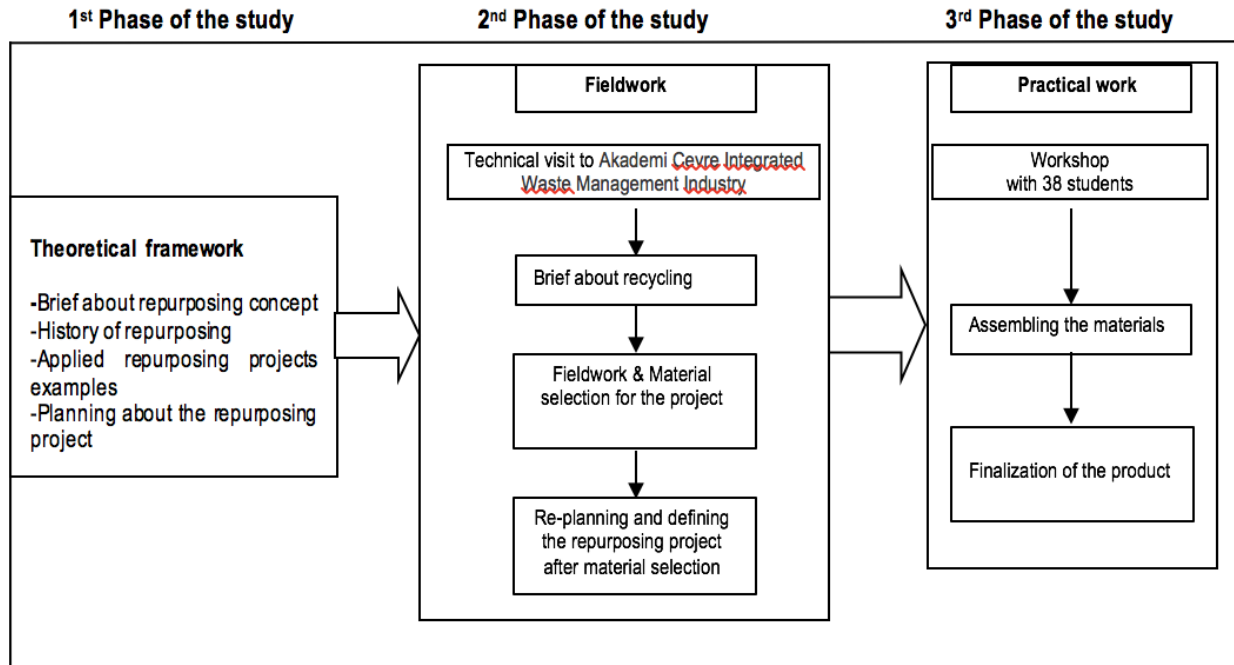


Figure 1. The structure of the case study

In the second phase of the study, aiming at university–industry cooperation, a technical trip was organised to visit Akademi Cevre Inc. – a leading industry partner company in recycling and waste management. In this context, knowledge on recycling and waste management was acquired and fieldwork was carried out within the scope of the application. As part of this field study, various waste materials were selected by the students for the repurposing project. The students selected materials according to their product needs, while also some students made later revisions about the project planning according to the materials. In the last stage, a workshop was held to transform the collected wastes into projects within the scope of the theoretical framework. During the workshop, the students drew sketches about their design, revisions were discussed, and according to the assembling methods, the products were finalised.

3.1. Outcomes

The study provided 38 projects, which were made from reused and waste materials. The projects did not consist of a particular product type, but rather a large variety of product designs that included furniture, accessory, lighting and household products. The four projects demonstrated in this paper are selected from the lighting and furniture design.



Figure 2. Mill lighting



Figure 3. Pipe lighting

In Figure 2, the repurposed project is a lighting design and the waste metal parts are from the automotive industry, waste bathroom fixtures and an old magnifier that had been used for soldering. The mills form the main structure of the lighting design; the rotating part lighting source is a spiral hose that can be adjusted to the horizontal magnifier for more effective lighting. The lighting design shown in Figure 3 is made from metal pipes, valves and pressure indicators. All metal parts were assembled by using pin bolts and attached to a rod end.

The furniture design shown in Figure 4 is made from two old stadium lighting projectors and the cables from the telecommunication industry. The projector lightings are attached from their necks and the handles of the projector are for the backrest and foot stand of the bar seat. The cables were knitted with knots for comfortable seating and the backrest was wrapped with cables around the handle. The side table shown in Figure 5 is made from waste parts from the automotive industry and waste old pipes. The vehicle instrument dashboard is used as a flat surface of the table and the table legs are old pipes covered with newspapers to avoid painting.



Figure 4. Bar seat



Figure 5. Side table

Project outputs were collected from our Industry Partner Akademi Cevre, Integrated Waste Management Industry Inc., and the materials of the disposed products were disassembled before the recycling process. Therefore, the design process started with the product planning, material research and selection of disassembled materials. During the workshop, the design process of the repurposed projects was examined and its integration into the eco-design life cycle was revealed. The repurposed projects of the students are made from locally sourced waste materials or disposed products to create items that relate to their specific needs. The output projects being produced are often simple, effective and the design process is different from the traditional industrial design process. It is important to note that, ‘when designing products from industrial waste however, a generic design process is not sufficient. It needs to be complemented with more specific up front-activities, as the design objectives are too vague in relation to the objectives of “traditional” product design’ (Ordenez et al., 2012, p. 8).

The starting point of the repurposing project is planning the product type and searching for the source materials for it. After material selection, the design concept and development stage starts and the phase continues with the production process.

4. Conclusion

This study was carried out within the scope of the Sustainable Design course which was an elective course for Industrial Design students and was completed in the last 2 weeks of the 15-week education process. In this context, the main approach is to design a product in the form of DIY and get the

understanding and applicability of repurposing concepts within the framework of sustainable design. During this practice, the students learned the principles of sustainable design and the relationship of the term sustainability with different disciplines in the 15-week lecture time. In the final application work, the students created a second chance to disposed products that were considered as waste materials and designed new products from them. Although repurposing is a different product development process than the sustainable design process, the students realised the necessity of integrating the material selection and reuse requirements at the beginning of the process while designing a new product. Repurposing is an approach that has different applications within the framework of sustainable design principles. Even though there are applications in which targets for repurposing were initially determined during the product design phase, this study has been carried out with the reference to the studies made based on materials in the form of DIY. The purpose of choosing this method was to provide a more flexible and dynamic environment to promote innovative and creative thinking for the students in the product design process.

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